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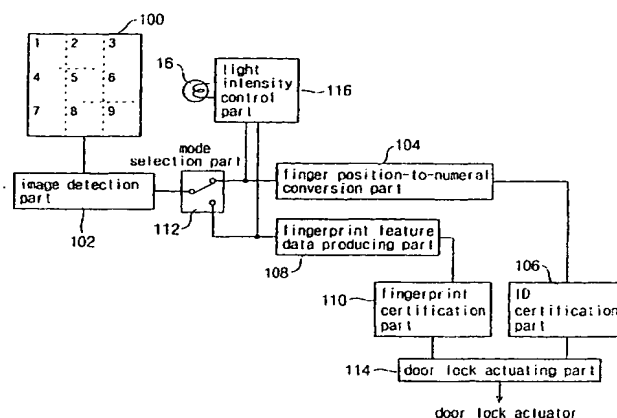
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(54) Title: FINGERPRINT AUTHENTICATION APPARATUS AND METHOD



(57) Abstract: Disclosed is a fingerprint authentication apparatus and method without a keypad, to which a user can input his/her ID number as well as a fingerprint, through a fingerprint acquisition window. The present invention includes a fingerprint acquisition window (100), the window being divided into a plurality of sections and different numerals being allocated to the different sections; a fingerprint image detection part (102) for detecting image of the fingerprint; a finger position-to-numeral conversion part (104) for locating the position of the finger currently touching the section of the fingerprint acquisition window (100), and for finding a numeral allocated to the corresponding section on which the finger is positioned; an ID certification part (106) for comparing the numerals with pre-stored ID to perform ID certification mode; a fingerprint feature data producing part (108); a fingerprint certification part (110) for comparing the fingerprint feature data with pre-stored feature data to perform fingerprint certification mode; a mode selection part (112) for switching the ID certification mode to the fingerprint certification mode, and vice versa.

WO 03/007220 A1

WO 03/007220 A1



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

FINGERPRINT AUTHENTICATION APPARATUS AND METHOD

Technical Field

5 The present invention relates to a fingerprint authentication apparatus and method without a keypad, to which a user can input his/her ID number as well as a fingerprint, through a fingerprint acquisition window.

Background Art

10 FIG. 1 briefly shows a conventional fingerprint authentication apparatus used for a door lock, which includes a key input module with which a user inputs his/her ID number, and a fingerprint input module. The key input module includes a keypad 10 exposed to the outside, and an input data processing section (not shown). The fingerprint input module includes a fingerprint acquisition window 12 exposed to the outside, and a fingerprint data
15 processing section (not shown).

 In a conventional fingerprint authentication apparatus shown in FIG. 1, a user to be authenticated to enter the entrance must enter his/her identification number (ID) by using the keypad 10, and then touch his/her fingerprint on the fingerprint acquisition window 12.

 However, because the keypad and the fingerprint acquisition window are exposed to
20 the outside, such an apparatus above may spoil the appearance of, for example, a building, etc., and it requires large installation spaces. In addition, frequently used keys may conspicuously be worn out or leave a trace indicating that particular numbers has been repeatedly used. So, an ID may have a possibility of being disclosed to unauthorized persons.

Disclosure of Invention

To solve the above problem in a conventional apparatus, it is an object of the present invention to provide a fingerprint authentication apparatus having a fingerprint acquisition window that receives both a registered user's ID and a fingerprint.

5 To achieve the above object, there is provided an fingerprint authentication apparatus comprising:

a fingerprint acquisition window, on which a user touches his/her fingerprint, the window being divided into a plurality of sections and different numerals being allocated to the different sections,

10 fingerprint image detection means for detecting image of the fingerprint on one of the sections of the fingerprint acquisition window and for providing a detected image as fingerprint image signals,

finger position-to-numeral conversion means for carrying out image processing by using the fingerprint image signals from the fingerprint image detection means in order to
15 locate the position of the finger currently touching the sections of the fingerprint acquisition window, and for finding a numeral allocated to the section on which the finger is positioned,

ID certification means for comparing the numerals found by the finger position-to-numeral conversion means with pre-stored ID to perform ID certification mode,

fingerprint feature data producing means for producing a fingerprint feature data by
20 means of image processing on the fingerprint image signals from the fingerprint image detection means,

fingerprint certification means for comparing the fingerprint feature data produced by the fingerprint image detection means with pre-stored feature data to perform fingerprint certification mode, and

mode selection means, positioned between the fingerprint image detection means and the finger position-to-numeral conversion means and the fingerprint feature data producing means, for switching the ID certification mode to the fingerprint certification mode, and vice versa.

5 In the above construction, the finger position-to-numeral conversion means may be replaced by a numeral recognition means, so that a user may enter an ID number by directly writing on a fingerprint acquisition window.

It is preferable that the above apparatus further comprises light intensity control means for irradiating normal intensity light to the fingerprint acquisition window when in
10 fingerprint certification mode and for irradiating lower intensity light to the fingerprint acquisition window when in ID certification mode.

According to another feature of the present invention, there is provided a fingerprint authentication method performed by the apparatus having a fingerprint acquisition window that receives a registered user's ID and fingerprint. The method comprises the steps of:

15 dividing the fingerprint acquisition window into a plurality of sections and allocating different numerals to the different sections,

detecting image of a fingerprint on one of the sections of the fingerprint acquisition window,

20 locating the position of a finger currently touching the section of the fingerprint acquisition window, and finding a numeral allocated to the section on which the finger is positioned,

comparing the numerals found by the locating step with pre-stored ID to perform ID certification mode,

producing a fingerprint feature data by means of image processing from the

fingerprint positioned on the fingerprint acquisition window, and

comparing the fingerprint feature data with pre-stored feature data to perform fingerprint certification mode.

In the above method, the steps of dividing the fingerprint acquisition window into a plurality of sections and allocating different numerals to the different sections; and locating the position of a finger currently touching the section of the fingerprint acquisition window, and finding a numeral allocated to the section on which the finger is positioned, may be replaced by the step of detecting image of a fingerprint from traces of finger's writing actions on the fingerprint acquisition window and recognizing numerals from the traces,

It is preferable that the above method further comprises the step of irradiating normal intensity light to the fingerprint acquisition window when in fingerprint certification mode, and irradiating lower intensity light to the fingerprint acquisition window when in ID certification mode.

Brief Description of Drawings

The above and other objects, features and advantages of the present invention will become more apparent from the following description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 shows an external appearance of a conventional fingerprint authentication apparatus for a door lock,

FIG. 2 shows an external appearance of a fingerprint authentication apparatus according to a preferred embodiment of the present invention,

FIG. 3 is a block diagram of a fingerprint authentication apparatus according to a preferred embodiment of the present invention,

FIG. 4 is an exemplified view showing a manner of capturing finger position according to the present invention, and

FIG. 5 is a block diagram of a fingerprint authentication apparatus according to another embodiment of the present invention.

5

Preferred Embodiments for Carrying out the Invention

Preferred embodiments will be described herein below with reference to the accompanying drawings.

<1st Embodiment>

10 The first embodiment includes a fingerprint acquisition window that has plurally divided sections and the numerals are allocated to the respective sections. FIG. 2 shows an appearance of a fingerprint authentication apparatus for a door lock, according to the first embodiment of the present invention. The keypad shown in FIG. 1 was removed and, instead, an only fingerprint acquisition window 14 is exposed outside. Inputting both ID
15 number and fingerprint through the fingerprint acquisition window 14 is the basic concept of the present invention. That is to say, the fingerprint acquisition window works both as an ID inputting keypad and as a fingerprint inputting window. Since there is no keypad, as in FIG. 2, the size of the external appearance is much reduced comparing to the conventional fingerprint authentication apparatus.

20 FIG. 3 is a block diagram of the fingerprint authentication apparatus for a door lock, according to the first embodiment. The apparatus is composed of:

a fingerprint acquisition window 100, on which a user touches his/her fingerprint, the window being divided into a plurality of sections and different numerals being allocated to the different sections,

a fingerprint image detection part 102 for detecting image of the fingerprint on one of the sections of the fingerprint acquisition window 100 and for providing a detected image as fingerprint image signals,

5 a finger position-to-numeral conversion part 104 for carrying out image processing by using the fingerprint image signals from the fingerprint image detection part 102 in order to locate the position of the finger currently touching the section of the fingerprint acquisition window 100, and for finding a numeral allocated to the corresponding section on which the finger is positioned,

10 an ID certification part 106 for comparing the numerals found by the finger position-to-numeral conversion part 104 with pre-stored ID to perform ID certification mode,

a fingerprint feature data producing part 108 for producing a fingerprint feature data by means of image processing on the fingerprint image signals from the fingerprint image detection part 102,

15 a fingerprint certification part 110 for comparing the fingerprint feature data produced by the fingerprint image detection part 102 with pre-stored feature data to perform fingerprint certification mode,

20 a mode selection part 112, positioned between the fingerprint image detection part 102 and the finger position-to-numeral conversion part 104 and the fingerprint feature data producing part 108, for switching the ID certification mode to the fingerprint certification mode, and vice versa.

In addition, the apparatus of the present invention may further include: a door lock actuating part 114 working only when both ID certification and fingerprint certification are successful; and a light intensity control part 116 for irradiating normal intensity light to the fingerprint acquisition window 100 when in fingerprint certification mode and for

irradiating lower intensity light to the fingerprint acquisition window 100 when in ID certification mode.

A typical optical fingerprint authentication apparatus requires a backlight for irradiating light to a finger to acquire a fingerprint. Because ID certification mode is for only finding the position of a finger, there is no necessity for irradiating normal intensity light to the fingerprint during ID certification. On the other hand, because fingerprint certification mode requires minute fingerprint image, it is necessary to irradiate normal intensity light to the fingerprint. By doing so, unnecessary power consumption can be reduced.

Meanwhile, which of the two modes (i.e., ID certification mode and fingerprint certification mode) should be performed first, is optional for a system designer. In typical, an ID certification mode is performed first, and a fingerprint certification mode follows.

To achieve the inventive concept of this invention, that is, a fingerprint acquisition window 100 being used both for fingerprint acquisition and for ID inputting, the manner shown in FIG. 4 may be utilized. FIG. 4 conceptually shows that ID numbers are found according to the position of a finger touching the fingerprint acquisition window 100. In FIG. 4 (a), even though the fingerprint acquisition window 100 has nine(9) divided sections, the number of the sections are optional. Actually, as long as there are two(2) sections or more, at least four(4) distinct IDs may be used. However, since the more ID numbers guarantee the stronger securities, it is preferable that the fingerprint acquisition window 100 is divided by reasonable numbers. Indication method of boundary lines and numerals is also optional. It is preferable that the boundary lines and numerals are indicated to be easily seen by a user, not to influence a fingerprint image detected by the fingerprint image

detection part.

FIG. 4(b) will explain the situation that a finger is positioned on the section numbered by "4". FIG. 4(b) shows the result of finger image detection by the fingerprint image detection part 102. A finger image 18 is detected so as to be positioned at the coordinate, $(0-x_1, y_1-y_2)$. Then, the finger position-to-numeral conversion part 104 finds a corresponding numeral "4", and forwards the result to the ID certification part 106. Locating the position of a finger image 18 may be performed by means of a gray level projection method, but it is not limited to this method. It is well known to the person ordinarily skilled in the image process field.

<2nd Embodiment>

The external and internal constructions of the second embodiment of the present invention (see FIG. 5) are similar to those of the first embodiment. However, in the case of second embodiment, a user may enter an ID number by directly writing on a fingerprint acquisition window 200 shown in FIG. 5. For this operation, the finger position-to-numeral conversion part 104 shown in FIG. 3 is replaced by a numeral recognition part 204.

When a mode selection part 212 selects a fingerprint certification mode, a fingerprint on a fingerprint acquisition window 200 is read to be performed fingerprint certification, like the case of the first embodiment. On the other hand, if an ID certification mode is selected, the numeral recognition part 204 recognizes numerals from traces of finger actions. The recognized numerals are dealt with as a certification ID during an ID certification mode.

The operation principle or numeral recognition algorithm of the numeral recognition part 204 is well known to a person ordinarily skilled in the relevant art. This technology is

universally disclosed at the fields of PDA, an electronic notebook, a set top box, etc.

From the foregoing, the concept of the present invention may be adapted to a door lock, attendance management, or any other access control devices. The present invention provides sharp reduction of the dimension, simple installation, good price, and fine view of appearance of a device.

While the invention has been shown and described with reference to a certain embodiment to carry out this invention, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A fingerprint authentication apparatus having a fingerprint acquisition window that receives both a registered user's ID and a fingerprint, the apparatus comprising:
 - 5 a fingerprint acquisition window, on which a user touches his/her fingerprint, the window being divided into a plurality of sections and different numerals being allocated to the different sections,
 - fingerprint image detection means for detecting image of the fingerprint on one of the sections of the fingerprint acquisition window and for providing a detected image as fingerprint image signals,
 - 10 fingerprint position-to-numeral conversion means for carrying out image processing by using the fingerprint image signals from the fingerprint image detection means in order to locate the position of the finger currently touching the sections of the fingerprint acquisition window, and for finding a numeral allocated to the section on which the finger is positioned,
 - 15 ID certification means for comparing the numerals found by the finger position-to-numeral conversion means with pre-stored ID to perform ID certification mode,
 - fingerprint feature data producing means for producing a fingerprint feature data by means of image processing on the fingerprint image signals from the fingerprint image detection means,
 - 20 fingerprint certification means for comparing the fingerprint feature data produced by the fingerprint image detection means with pre-stored feature data to perform fingerprint certification mode, and
 - mode selection means, positioned between the fingerprint image detection means

and the finger position-to-numeral conversion means and the fingerprint feature data producing means, for switching the ID certification mode to the fingerprint certification mode, and vice versa.

2. The apparatus of claim 1, wherein the mode selection means selects an ID certification mode prior to a fingerprint certification mode.
3. The apparatus of claim 1, further comprising:
 - light intensity control means for irradiating normal intensity light to the fingerprint acquisition window when in fingerprint certification mode and for irradiating lower intensity light to the fingerprint acquisition window when in ID certification mode.
4. A fingerprint authentication apparatus having a fingerprint acquisition window that receives both a registered user's ID and a fingerprint, the apparatus comprising:
 - a fingerprint acquisition window, on which a user touches his/her fingerprint,
 - fingerprint image detection means for detecting image of the fingerprint on the fingerprint acquisition window and for providing a detected image as fingerprint image signals,
 - numeral recognition means for carrying out image processing by using the fingerprint image signals from the fingerprint image detection means in order to recognize numerals from traces of finger actions on the fingerprint acquisition window,
 - ID certification means for comparing the numerals found by the numeral recognition means with pre-stored ID to perform ID certification mode,
 - fingerprint feature data producing means for producing a fingerprint feature data by means of image processing on the fingerprint image signals from the fingerprint image detection means,

fingerprint certification means for comparing the fingerprint feature data produced by the fingerprint image detection means with pre-stored feature data to perform fingerprint certification mode, and

mode selection means, positioned between the fingerprint image detection means and the finger position-to-numeral conversion means and the fingerprint feature data producing means, for switching the ID certification mode to the fingerprint certification mode, and vice versa.

5 5. The apparatus of claim 2, wherein the mode selection means selects an ID certification mode prior to a fingerprint certification mode.

10 6. The apparatus of claim 2, further comprising:

light intensity control means for irradiating normal intensity light to the fingerprint acquisition window when in fingerprint certification mode and for irradiating lower intensity light to the fingerprint acquisition window when in ID certification mode.

15 7. A fingerprint authentication method performing by the apparatus of claim 1 having a fingerprint acquisition window that receives both a registered user's ID and a fingerprint, the method comprising the steps of:

dividing the fingerprint acquisition window into a plurality of sections and allocating different numerals to the different sections,

20 detecting image of a fingerprint on one of the sections of the fingerprint acquisition window,

locating the position of a finger currently touching the section of the fingerprint acquisition window, and finding a numeral allocated to the section on which the finger is positioned,

comparing the numerals found by the locating step with pre-stored ID to perform

ID certification mode,

producing a fingerprint feature data by means of image processing from the fingerprint positioned on the fingerprint acquisition window, and

comparing the fingerprint feature data with pre-stored feature data to perform fingerprint certification mode.

5

8.

The method of claim 7, further comprising the step of:

irradiating normal intensity light to the fingerprint acquisition window when in fingerprint certification mode, and irradiating lower intensity light to the fingerprint acquisition window when in ID certification mode.

10

9.

A fingerprint authentication method performed by the apparatus of claim 4 having a fingerprint acquisition window that receives a registered user's ID and fingerprint, the method comprising the steps of:

detecting image of a fingerprint from traces of finger's writing actions on the fingerprint acquisition window and recognizing numerals from the traces,

15

comparing the numerals recognized by the detecting and recognizing step with pre-stored ID to perform ID certification mode,

producing a fingerprint feature data by means of image processing from the fingerprint positioned on the fingerprint acquisition window, and

comparing the fingerprint feature data with pre-stored feature data to perform fingerprint certification mode.

20

10. The method of claim 9, further comprising the step of:

irradiating normal intensity light to the fingerprint acquisition window when in fingerprint certification mode, and irradiating lower intensity light to the fingerprint acquisition window when in ID certification mode.

DRAWINGS

Fig. 1

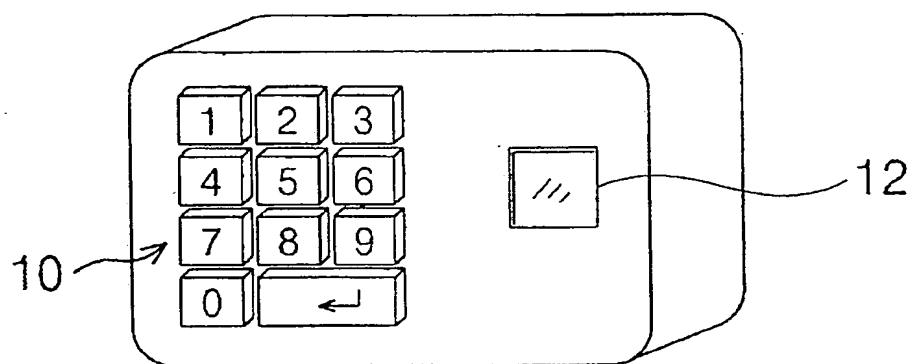


Fig. 2

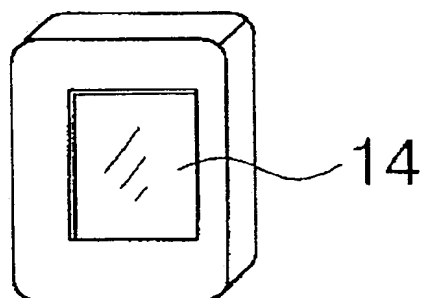


Fig. 3

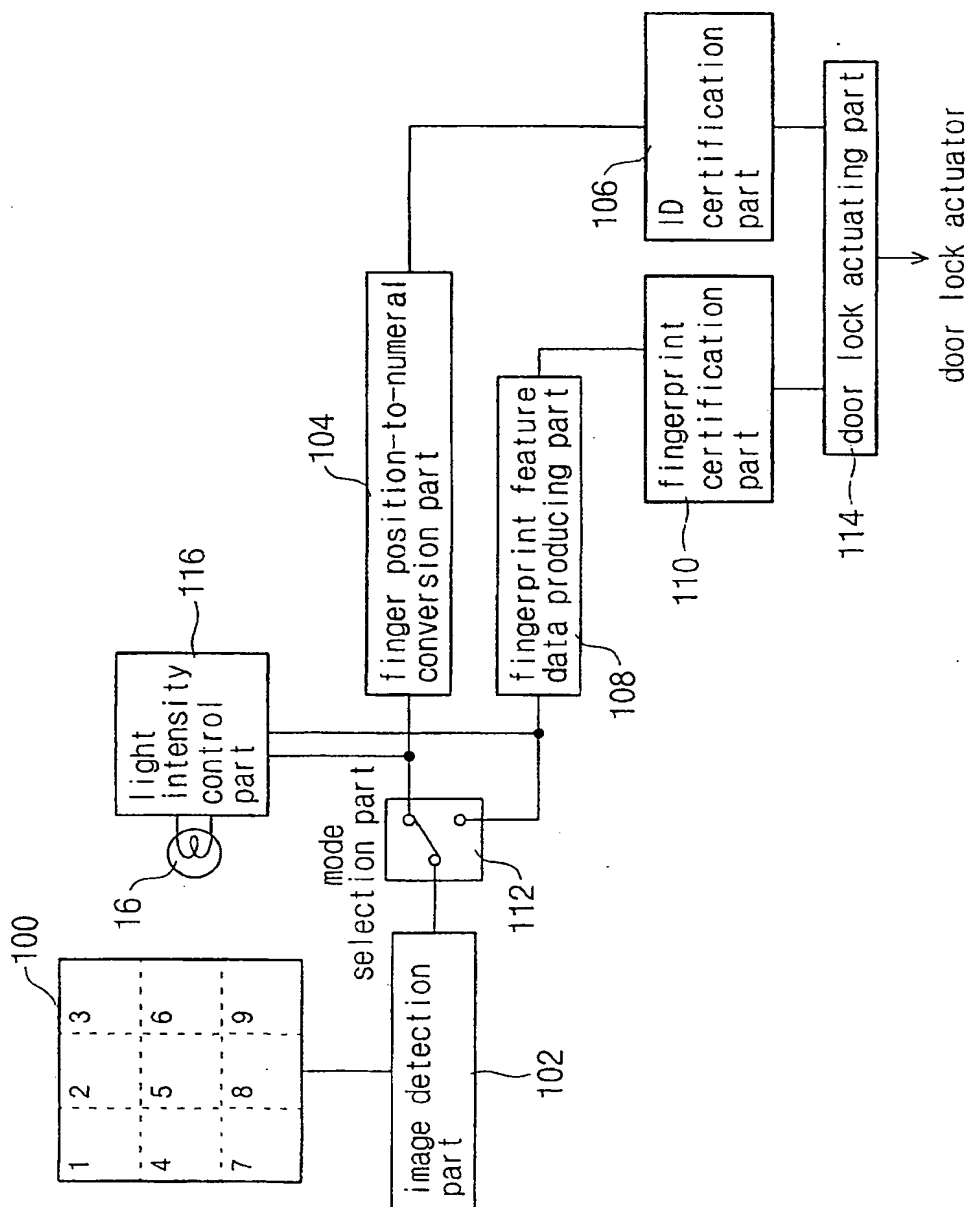


Fig. 4

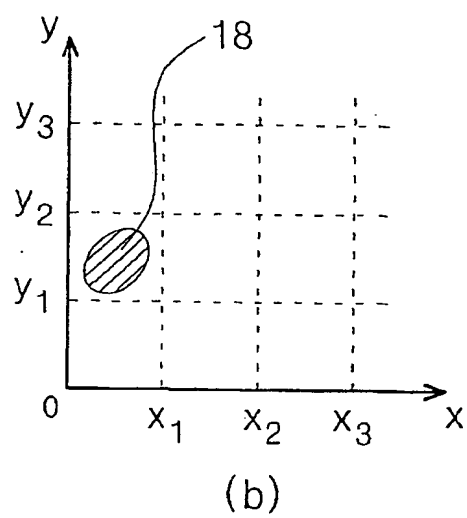
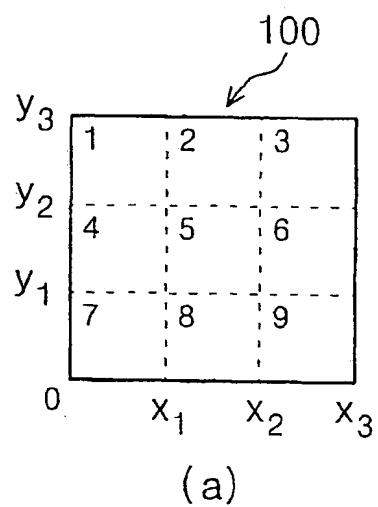
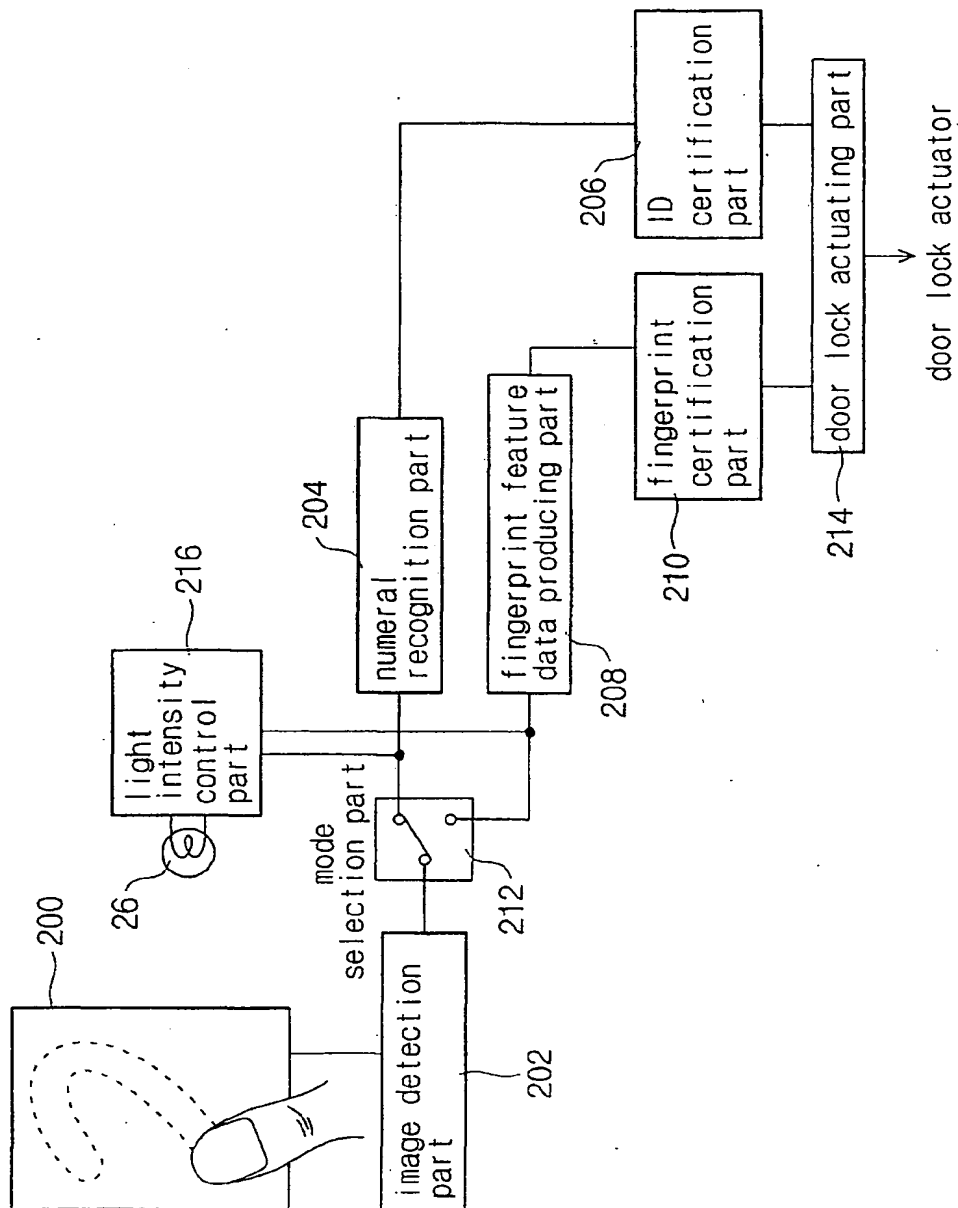


Fig. 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR02/01310

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 G06K 9/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
(IPC7) G06K, G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korea patents(utility models) and patent(utility model) applications for invention since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
KIPONET

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP11283026A (Matsushita Electric Inc Co Ltd) Octobet 15, 1999 See the abstract and figures	1-7
A	KR20-0210281Y1 (Kil, Young-Sun) January 15, 2001 See the whole documents	1-7
A	KR2000-0032603A (Hunno Technologies Inc) June 15, 2000 See the abstract	1-7

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP11283026A	15.10.1999	US6360004BA	19.03.2002
KR20-0210281Y1	15.01.2001	NONE	
KR2000-0032603	15.06.2000	NONE	